Motor Management Ensures Easy Starting and Reliable Operation of a Rotary Crusher

Cement Industry Application Profile

At the Bündner Cement AG, a giant stone crusher breaks up thousands of tons of limestone every day. The crusher motor bears a direct influence on production and to start it with as little stress as possible, provide comprehensive protection and operate it cost-effectively, the works engineers were looking for motor management of the highest quality. They chose the electronic control and protection system of the 825 series.

At Untervaz a few kilometres to the west of Chur the capital of the Canton of Grisons and the gateway to the Alps in the south-east of Switzerland, the extensive works of the Bündner Cement AG produces 850,000 tons of cement a year. In the first year of operation forty years ago, the annual production was only 100,000 tons. Production increased steadily over the years to its present high level as a result of a good choice of site, professional know-how and a prosperous building industry. Today, the works supplies the building industry of the entire region.
The most valuable resource of a successful industrial undertaking is a conscientious workforce. For the workforce to develop its full potential, however, it has to be supported by highly efficient machines.

Bündner Cement AG (Switzerland) uses explosives to quarry limestone. The stone produced in this way is in blocks up to a cubic metre in size that have to be crushed by a variety of rotary crushers. The availability of the crushers directly influences production. Modern motor management ensures that the biggest of them starts safely and operates reliably.

That is why the Bündner Cement AG relies on Rockwell Automation solutions to switch and protect its low-voltage equipment.

A 355 kW motor at the beginning of the production line

The raw material from which cement is manufactured is limestone. In Untervaz, limestone is quarried using explosives. This produces blocks of stone up to two tons in weight and a cubic metre in

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Electrical Engineer Walter Büchel on the 355 kW motor of the biggest rotary crusher that reduces 5,000 tons of stone a day. With the old time-controlled Y/delta switching system, varying charges of stone and fluctuating temperature caused problems with high starting currents. Y/delta starting in the case of the new electronic control and protection system of the 825 series is current-controlled and therefore always takes place at the right instant for minimum current.

size that have to be reduced on the spot to pieces of stone roughly the size of a fist with edges 80 mm long. Bündner Cement AG has a number of crushers in operation every day performing this task. The largest is a rotary crusher with a funnel diameter of 4.8 m, a height of 15 m and a weight of 270 tons — a workhorse in the truest sense of the word. "On average, we crush 5,000 tons of stone a day in this unit", Walter Büchel, Electrical Engineer, said. Naturally, to crush that amount of stone there has to be a motor drive with similarly impressive data. The squirrel-cage motor at Untervaz has a rating of 355 kW, "draws" a current of 477 A, has a rated voltage of 500 VAC and is accelerated after starting to its operating speed of 1,490 rpm. The force is transmitted via a special hydraulic coupling which includes a large delay chamber controlled by valves that enables the motor to be accelerated to its rated speed with virtually no load. The delay chamber is emptied when the unit reaches rated speed and the full torque of the hydraulic coupling becomes effective.

Current-controlled Y/delta starter achieves ideal starting

Mr. Büchel explained that previously the motor was started by a conventional starter with electromechanical timing relays. "The problem was the differing charges of stone and the temperature of the equipment that resulted in widely different electrical starting conditions. In unfavourable circumstances, the Y/delta switchover after a fixed time was almost as bad as a direct start and the starting current could trip the HV circuit-breaker."

With the aim of starting the motor more safely and avoiding false trips, improving operating efficiency and protecting the motor effectively, the engineers at Bündner Cement AG decided to install a modern cost-effective control and protection system with current-controlled Y/delta starting, all features that are incorporated in Rockwell Automation's 825 series (formerly the Sprecher+Schuh CET 4).

The main problem at Bündner Cement AG is that when the motor and coupling of the rotary crusher are cold, the ideal Y-connected starting time is 9 seconds, while at normal operating temperature it reduces to 5 seconds. Using a timer, it is unavoidable that the Y/delta switchover takes place at times too early and at other times too late, if the unit has to be started irrespective of temperature and starting load. In both cases, the consequence is an excessively high starting current, overload and even damage to the plant.

Since the Y/delta switchover is current-controlled on the 825 series of electronic control and protection systems (option 825-MLV with Y/delta starter), it takes place at the best possible instant regardless of load and temperature.

Backup timer function for added safety

As those familiar with such machines know, it can happen that the load is so high that the motor current never falls low enough to permit Y/delta switching. How do we cope with that situation? To cover this eventuality, the 825 series of units have a backup timer

function that forces the switchover after a delay which can be set anywhere between 1 and 240 seconds. Bündner Cement AG wanted this option as well and set the time to 10 seconds.

This proved to be just the right combination according to Felix Opprecht, the Project Engineer at Bündner Cement AG: “The installation of the Rockwell Automation control and protection system has noticeably improved the operation of our big rotary crusher and interruptions have dropped to a minimum.”

Bündner Cement AG can thus rely on its rotary crusher to perform its daily work efficiently without complaining, not least of all because the 825 series of control and protection systems precisely models the thermal state of the motor under all operating conditions. This enables maximum utilisation of the plant without putting the motor at risk. Should in spite of this a fault occur that trips the unit, it can be quickly localised and cleared and downtime kept to the absolute minimum using the fault diagnostic feature. Overall plant availability is therefore higher and high productivity maintained. Using an electronic control and protection system of the 825 series to maintain the productivity of a major cement manufacturer is an example of a genuine motor management solution of the kind Rockwell Automation offers to its customers all over the world. With this as with all technological development at Rockwell Automation, the objective is to enable the user to operate as a successful business in his particular market.

Production at Bündner Cement AG has grown steadily over the forty years that the plant has been in operation. Over this period, the demands with respect to reliability and functionality that the industrial automation components and systems are expected to fulfil have also changed dramatically. Rockwell Automation’s motor management system was just the high standard of technical and cost-effective solution the customer was looking for. With the Y/delta starting option 825-MLV, the electronic control and protection system of the 825 series executes an optimum current-controlled switchover. Starting is therefore safe, operation reliable and plant availability a maximum even with a widely varying load.

In brief

Problem: A rotary crusher with a 355 kW motor drive operated by the Bündner Cement AG has to be Y/delta started reliably without generating excessively high starting currents (and all the negative consequences) regardless of load and temperature.
Solution: With option 825-MLV for current-controlled Y/delta starting, the electronic control and protection system of the 825 series guarantees Y/delta switching at the right time every time. Should the starting current remain high due to an exceptionally high load, a backup timer function forces Y/delta switching after a time set by the user between 1 and 240 seconds. The precise modelling of the thermal conditions in the motor by the protection permits maximum utilisation of the crusher without putting the motor at risk even in the case of:

- a frequently changing load
- short overloads
- heavy duty starting
- asymmetrical loads (NPS)

The Project Engineer at Bündner Cement AG talks of the “noticeably improved” operation of the plant since the control and protection system was installed.

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Rockwell Automation Headquarters, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414 382-2000 Fax: (1) 414 382-4444
Rockwell Automation European Headquarters, Avenue Hermann Debroux, 46, 1160 Brussels, Belgium, Tel: (32) 2 663 06 00, Fax: (32) 2 663 06 40
Rockwell Automation Asia Pacific Headquarters, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846
World Wide Web: http://www.ab.com

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